MARICOPA COUNTY

2020

Eye To The Future

Maricopa County, Arizona
August, 2001

WATER RESOURCES

ACKNOWLEDGEMENTS

Preparation of this report was made possible by the cooperative efforts of many public and private stakeholders. Maricopa County extends its appreciation to all those that participated in this process, including the Maricopa County Board of Supervisors, the Planning and Zoning Commission, and the many citizens and stakeholders that attended public and focus group meetings regarding this important issue.

Board of Supervisors

Fulton Brock, District 1
Don Stapley, District 2
Andy Kunasek, District 3
Janice K. Brewer, District 4 (Chairman)
Mary Rose Wilcox, District 5

Planning and Zoning Commission

Bob Beckley, District 1
Mark Pugmire, District 2
Clancy Jayne, District 3
Bill Clayburg, District 4
Abe Harris, District 5 (Chairman)

Sal DiCiccio, District 1
Richard Gulbrandsen, District 2
Dick Smith, District 3
Carole Hubbs, District 4
Jimmie Munoz, District 5

Comprehensive Planning Team (Planning and Development Department)

Joy Rich, AICP, Director
Matt Holm, AICP, Principal Planner
Jackie Nolan, Planner (project manager)
*Neil Urban, AICP, Planning Manager

* Resigned January, 2001

TABLE OF CONTENTS

Sections

Tables

Figures

WATER RESOURCES

Introduction

The Water Resources element helps fulfill Maricopa County's obligation under the Growing Smarter Plus Act. Specifically, Growing Smarter Plus requires that Maricopa County address water resources by including in its comprehensive plan an inventory of county water supplies, as well as calculations of historical and projected water demand. Detailed sections on issues relevant to water use and available supplies for future growth in the county are also included, as are sections describing practices for managing future water supplies and comprehensive goals, objectives and policies to help guide land use decisions.

State Law and Purpose

The Growing Smarter Plus Act requires that Maricopa County include a water resources element in its comprehensive plan that provides an inventory of currently available water supplies and an analysis of how future growth will be adequately served with these water supplies. With the recent adoption of the Arizona Department of Water Resources' Third Management Plans, new regulatory requirements need to be met by municipalities. The Third Management Plans require not only the practice of water conservation by water users, but also emphasize augmentation of existing supplies with greater use of renewable supplies in the future.

Renewable supplies that are available in Maricopa County include Central Arizona Project (CAP) water, which comes from the Colorado River, surface water, and effluent. The use of each renewable source has certain obstacles, especially the ability to transport the water from the source to the user.

Water resource planning is an important consideration in planning for future growth. All water sources need to be considered in long-term, comprehensive water planning.

Water Supply Inventory

Maricopa County has been able to support sustained urban growth due in part to its adequate water supply. Water supplies in Maricopa County include surface water, CAP water, groundwater, and effluent or treated wastewater. **Figure 1** identifies groundwater basins and subbasins within the county. An overview of available water supplies follows.

Surface Water

Arizona law defines surface water as "the waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels, whether perennial or intermittent, flood, waste, or surplus water, and of lakes, ponds

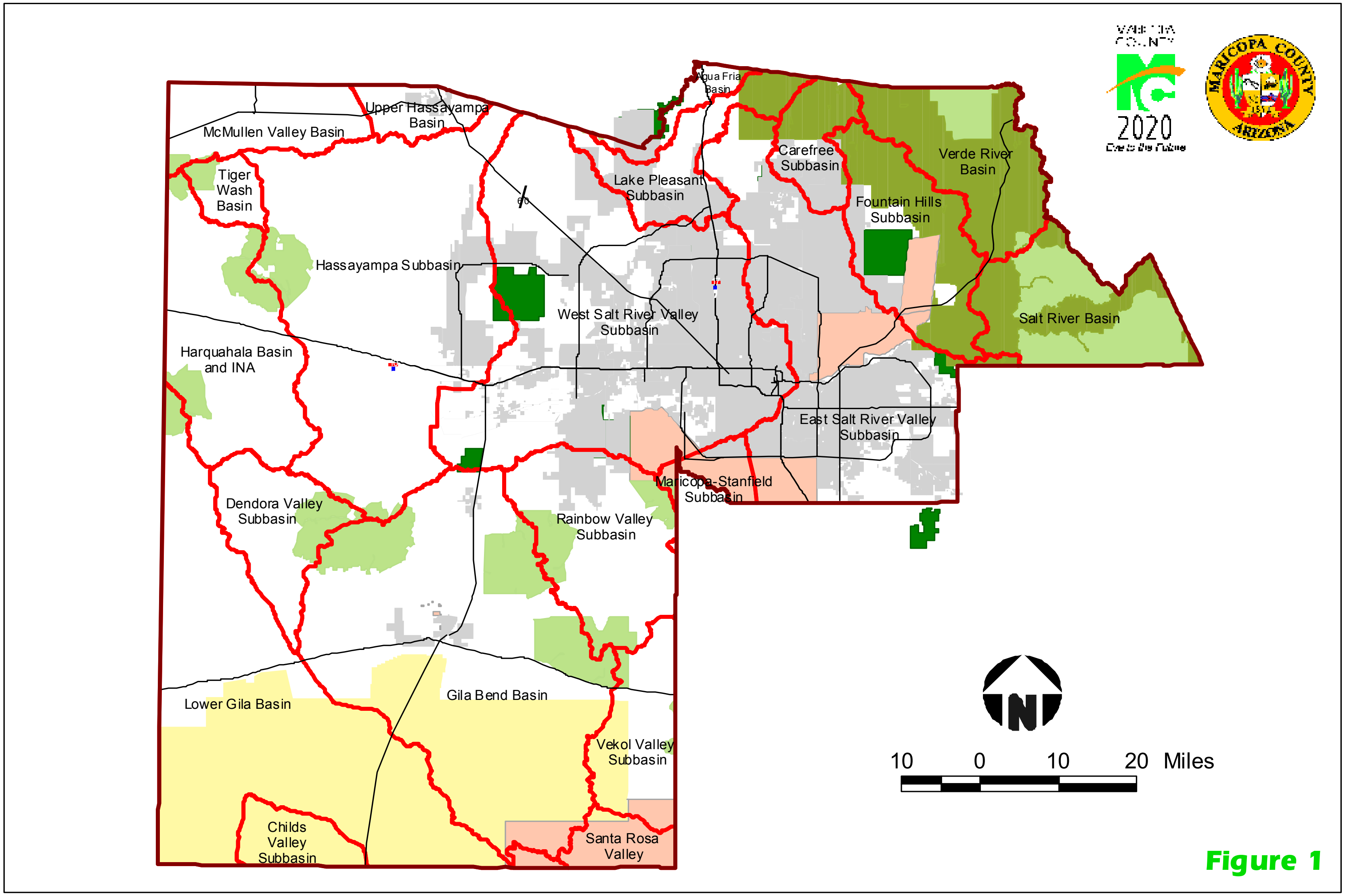

Figure 1

County Boundary
Basin/Subbasin Boundary
Wilderness Area
Tonto National Forest
Maricopa County Park
Barry M. Goldwater Range
Incorporated Area
Indian Community
Highways

Groundwater Basins & Subbasins

Maricopa County Planning & Development Department and springs on the surface" (A.R.S. § 45-101(9)). These surface waters are subject to the "doctrine of prior appropriation." Prior appropriation is based on the tenet "first in time, first in right." The first person to put the water to beneficial and reasonable use acquires a right superior to later appropriators. This person or their successors have the right to use a specified amount of water for a stated beneficial use each year, subject only to the rights of prior appropriators.

Surface water in Maricopa County includes the Salt, Verde, Agua Fria, Gila and Hassayampa rivers. Flows from the Salt, Verde, Agua Fria and Gila rivers are stored in reservoirs for users downstream. On the Salt River, storage reservoirs include Roosevelt Lake, Apache Lake, Canyon Lake and Saguaro Lake. Reservoirs on the Verde River include Bartlett Lake and Horseshoe Lake. On the Agua Fria River, Lake Pleasant stores water flowing into the lake from the river as well as CAP water. **Table 1** displays storage capacity for each reservoir and total storage capacity for all surface water reservoirs.

The **Salt River** originates in eastern Arizona and drains approximately 6,000 square miles of the east central part of the state. The river enters Maricopa County north of the Superstition Wilderness, flows southwest through the cities of Mesa, Tempe, and Phoenix, and flows into the Gila River near Laveen. Water flow in the Salt River is regulated by the reservoir system previously mentioned, and additionally by the Granite Reef Diversion Dam. The Granite Reef Diversion Dam, located between Sawik Mountain and the Usery Mountains, has no storage and diverts almost all of the flows into the Salt River Project (SRP) canal system for agricultural, municipal, and industrial water use. The Salt River is ephemeral (flowing for a brief time only) downstream from this dam, mainly flowing in response to flooding or reservoir releases. The last eight miles of the Salt River are perennial (continuing without interruption) due to effluent discharge from the City of Phoenix 23rd and 91st Avenue wastewater treatment plants.

The **Verde River** originates in Chino Valley north of Prescott and enters Maricopa County west of the Mazatzal Wilderness. The Verde drains approximately 7,000 square miles of central Arizona, and its flow is regulated by Horseshoe and Bartlett Dams. The river flows south through the Fort McDowell Indian Community and joins the Salt River between Stewart Mountain Dam and Granite Reef Diversion Dam.

The **Agua Fria River** originates northeast of Prescott and drains part of central Arizona between Prescott and Phoenix. The river enters Maricopa County west of Rock Springs, Arizona and flows south through Peoria, El Mirage, Youngtown, and Avondale before joining the Gila River south of Avondale. The Agua Fria River and tributaries drain approximately 2,000 square miles. The river is controlled in the northern part of the county by New Waddell Dam, which forms Lake Pleasant. The Bureau of Reclamation completed construction on New Waddell Dam in 1994 to store Colorado River water for CAP use. Almost all the natural flow of the Agua Fria—24,561 acre-feet (one acre-foot

TABLE 1 Surface Water Reservoir Storage Capacity	
Reservoir	**1995 Storage Capacity (acre-feet)**
Salt River Reservoirs	
Roosevelt Lake (after 1996 modifications: 1,591,800)	1,336,734
Apache Lake	245,138
Canyon Lake	57,852
Saguaro Lake	69,795
Verde River Reservoirs	
Bartlett Lake	178,186
Horseshoe Lake	131,427
Agua Fria/CAP Reservoirs	

is equal to 325,851 gallons) per year on average—is diverted by the Maricopa Water District at Camp Dyer Diversion Dam into the Beardsley Canal. The Agua Fria River is ephemeral downstream from the dam, mainly flowing in response to flooding or reservoir releases. Average annual flow near Avondale, including flow from New River and Skunk Creek, is approximately 23,200 acre-feet.

The **Gila River**, which flows northwest and west of the Estrella Mountains and the Buckeye Hills, originates in western New Mexico and enters Maricopa County directly east of the Estrella Mountains. The river drains most of southern and central Arizona. The Gila is regulated by Ashurst-Hayden Dam, which diverts water for the San Carlos Irrigation Project. Between the dam and the confluence with the Salt River south of Avondale, the Gila River is ephemeral, flowing mainly in response to flooding or reservoir releases upstream. West of the confluence with the Salt River, the Gila flows perennially due to effluent discharges in the Salt River mentioned previously. The Buckeye Irrigation Company and the Arlington Canal Company divert much of this water for agricultural irrigation, while some is diverted for use by the Palo Verde Nuclear Generating Station near Wintersburg. The river continues flowing west, south, and southwest until it exits Maricopa County near Agua Caliente. The average annual flow of the Gila River at Gillespie Dam, located south of the Town of Arlington, has been 96,100 acre-feet.

The **Hassayampa River** is noteworthy more for groundwater replenishment than as a surface water supply. The river originates in the Bradshaw Mountains south of Prescott and drains an area of approximately 1,470 square miles in west-central Arizona. The Hassayampa enters Maricopa County north of the Town of Wickenburg and flows south across the Hassayampa Subbasin, joining the Gila River east of Arlington. Approximately seven miles south of Wickenburg, almost the entire runoff of the river sinks into the bed of the river and recharges the aquifer system. This occurs because of a major fault that crosses the Hassayampa at a place known as the Narrows. Upstream of this site, at Box Dam, the average annual flow of the river is approximately 17,400 acre-feet.

Other surface water tributaries include Queen Creek, Cave Creek, Skunk Creek, New River, Waterman Wash, and Centennial Wash. **Queen Creek** is an ephemeral stream originating in the Superstition Mountains and flowing west to the Roosevelt Water Conservation District Canal north of the Santan Mountains. Historically, the average annual flow of Queen Creek has been approximately 3,000 acre-feet. **Cave Creek**, an ephemeral stream that originates in northern Maricopa County east of the New River Mesa, flows southwest to the Arizona Canal Diversion Channel in northwest Phoenix. The average annual flow of Cave Creek north of the Arizona Canal is 3,130 acre-feet. **Skunk Creek**, a small ephemeral stream, flows south from its origin near the southern end of the New River Mountains and joins New River near the City of Peoria. The average annual flow of Skunk Creek near the Union Hills is approximately 1,000 acre-feet. **New River** begins in the New River Mountains in northern Maricopa County and flows intermittently southwest, joining the Agua Fria River east of Litchfield Park. The average annual flow of the stream at Bell Road near Peoria is approximately 8,700 acre-feet.

Waterman Wash, which drains the Rainbow Valley Subbasin, originates ten miles west of the unincorporated community of Mobile in the southwestern part of the county. The unregulated ephemeral stream joins the Gila River east of Buckeye. The average annual flow of the wash is believed to be quite small. **Centennial Wash**, a large ephemeral stream, begins a few miles north of Aguila, flows southwest through McMullen Valley and then southeast across the Harquahala Plain. A small portion of the wash enters and exits in the far northwestern corner of Maricopa County, then reenters the county south of Interstate 10, traveling southeast until it joins the Gila River near Arlington. The average annual flow of Centennial Wash near Arlington is approximately 2,700 acre-feet.

Central Arizona Project Water

The CAP, a multipurpose water resource development and management project, delivers Colorado River water into Maricopa, Pinal, and Pima counties. It consists of a system of pumping plants and aqueducts that convey the river water from the Bill Williams River arm of Lake Havasu to the project service area. The aqueduct system runs for about 336 miles from Lake Havasu to its end southwest of Tucson. The CAP was constructed to deliver 1.415 million acre-feet annually of Arizona's allocation of 2.8 million acre-feet per year of Colorado River water. As much as 1.8 million acre-feet can be delivered through the CAP aqueduct if it is used at maximum capacity.

Colorado River water is shared by seven western states and Mexico. Wyoming, Colorado, Utah, New Mexico, and Arizona above Lee's Ferry share an annual allocation of 7.5 million acre-feet. California, Nevada, and Arizona below Lee's Ferry share an annual allocation of 7.5 million acre-feet. Mexico has an annual allocation of Colorado River water of 1.5 million acre-feet.

Colorado River water is stored in Lake Pleasant for CAP use. In winter months, Colorado River water is pumped uphill into Lake Pleasant using a pumping/generating plant. During the summer months, water is released from the dam to CAP users. As the water flows back through the pumping/generating plant, non-polluting hydroelectric power is generated.

The CAP is managed and operated by the Central Arizona Water Conservation District (CAWCD). The CAWCD is a political subdivision of the State of Arizona and a tax-levying public improvement district under the laws of the state, responsible for CAP system maintenance and operations, repayment obligations, allocation contracts, and creating water resource management programs for Arizona.

Originally allocated in 1983 to Indian users, non-Indian municipal and industrial users, and agricultural users that requested allocations, CAP water is not freely available to everyone in Maricopa County. As of March 1995 CAP allocations in Maricopa County totaled 294,822 acre-feet for municipal and industrial users, 190,700 acre-feet for Indian users, and 18.2% of the agricultural supply for agricultural users. By May 2000, CAP allocations for Maricopa County users equaled 326,409 acre-feet for municipal and industrial users, 230,533 acre-feet for Indian users, and 18.2% of the total agricultural supply for agricultural users. CAP allocations change from year to year due to settlement of Indian water rights claims and transfers of subcontracts from one entity to another. In some cases, as with Anthem development in north Phoenix, Indian water rights have been sold or leased to municipalities or water providers.
The relatively high cost of CAP water compared to pumping groundwater caused several irrigation districts to turn back their original allocations. Unused agricultural CAP water has been pooled and offered by CAWCD for use by irrigation districts at a substantial discount. Excess CAP water from unused allocations is generally being recharged either directly or indirectly. Direct recharge takes place in basins, streambeds, or injection wells. During direct recharge, a chosen site is systematically flooded with CAP water and the water is allowed to percolate down through the soil, eventually reaching the aquifer. Each site is carefully scrutinized and tested for soil contamination, nearness to the CAP aqueduct, aquifer permeability, and aquifer storage capacity. Indirect recharge occurs as stored water at groundwater savings facilities, where CAP water replaces groundwater pumping and allows the groundwater to remain in the aquifer.

The Arizona Water Banking Authority (AWBA) was created in 1996 to maximize the long-term benefit of Arizona's share of Colorado River water. In the past, southern California users consumed most of Arizona's unused allotment of Colorado River water. The AWBA protects this resource and helps secure water supplies for the future by storing Arizona's unused Colorado River water underground. The AWBA pays for the delivery and storage of unused Colorado River water that is transported through the CAP aqueduct and either stored underground in existing aquifers or used directly by irrigation districts in-lieu of pumping groundwater. The AWBA is funded by an ad valorem property tax levied by CAP, general fund appropriations, groundwater withdrawal fees collected within the state's Active Management Areas, and the proceeds of interstate water banking activities. The amount of excess CAP water available for storage by the AWBA will decrease as Arizona uses more of its Colorado River allocation.

An obstacle to more widespread use of CAP water is the lack of infrastructure needed to convey this water to those users that are far from the CAP aqueduct. CAWCD has offered short-term contracts for unused municipal and industrial water (known as excess CAP water) to users in the county. Municipal and industrial allocations of CAP water may change in the future as entities buy or sell unused allocations. Additionally, CAP water may at some point be used to settle Indian water rights claims. However, it is projected that full utilization of CAP water supplies in the state will be reached by the year 2040.

Groundwater

Groundwater is defined by statute as "... water under the surface of the earth regardless of the geologic structure in which it is standing or moving. Groundwater does not include water flowing in underground streams with ascertainable beds and banks" (A.R.S. § 45-101(5)). Groundwater is an essential element of Maricopa County's water supply since it currently accounts for approximately 40% of all water use. Groundwater pumping can create environmental hazards such as lowering of groundwater levels, subsidence and earth fissuring, aquifer compaction resulting in loss of aquifer storage space, and water quality problems due to the migration of poor quality water and deterioration of aquifer water quality with depth.

Groundwater in Maricopa County is found primarily in basin-fill sediments. Three distinct water-bearing units make up most of the subbasins in the county. These units are an upper alluvial unit, a middle fine-grained unit, and a lower conglomerate unit. Most groundwater is pumped from the middle fine-grained unit, although conditions vary across the county. Bedrock, consisting of various metamorphic and igneous rocks, underlies the basin-fill sediments. Bedrock has little groundwater storage or production capacity and is therefore not considered to be an aquifer.

Groundwater is normally hidden from view and as such is difficult to visualize its occurrence and movement. Groundwater conditions change over time due to natural and human-induced fluctuations in the amount of water added or extracted. Because groundwater flows very slowly underground, the effects of pumping and recharge can alter the shape of a water table for long periods of time. Water that is naturally or artificially recharged can mound up underground, while pumping can create a cone of depression in the water table where the table has fallen or risen during a given time period. A cone of depression is created when a significant amount of water is pumped from the ground, thereby lowering the water level and creating a conical depression in the water table.

There are four groundwater basins and eight groundwater subbasins in Maricopa County (**Figure 1)**. Groundwater basins include the Harquahala, McMullen Valley, Gila Bend, and the Lower Gila. Groundwater subbasins include the East Salt River Valley, West Salt River Valley, Hassayampa, Rainbow Valley, Fountain Hills, Lake Pleasant, Carefree, and Vekol Valley. Each basin and subbasin has its own unique hydrogeologic characteristics and a number of factors influence groundwater conditions in each. These include groundwater inflow and outflow, depth to groundwater, withdrawals and recharge, surface water conditions, subsidence potential, and quality of groundwater in different locations.

Groundwater Basins

The **Harquahala Basin**, which contains 765 square miles, is located in southwestern Maricopa County. It is a broad alluvial valley surrounded by mountains that is typical of the basin and range physiographic province. The basin-fill alluvium is the main aquifer, with minor amounts of groundwater occurring in the alluvium found in the mountain washes.

Nearly all groundwater pumped from the main aquifer in the Harquahala Basin is used for crop irrigation. As of 1988, the amount of groundwater available to 1,200 feet below land surface is calculated at 15.5 million acre-feet. (Hydrologic studies were used to determine the amount of groundwater available to 1,200 and 1,500 feet below land surface.) Groundwater availability has increased since the 1970s due to a decrease in irrigated land and the introduction of CAP water for crop irrigation in 1985. Natural groundwater recharge into the basin is estimated to be only 1,000 acre-feet per year, most of which comes from infiltration of runoff through the alluvium in Centennial Wash. Very little direct rainfall recharges the aquifer due to low precipitation and high evapotranspiration rates. Evapotranspiration occurs when moisture contained in soil is lost as evaporation and from plants grown on the soil through transpiration. Infiltration from the CAP aqueduct due to seepage amounts to an estimated 5,900 acre-feet of water per year. Because continual pumping of groundwater for crop irrigation occurred during the 1950s and 1960s, a large cone of depression formed in the southeastern part of the basin. Currently, groundwater flow is from the basin edges into the cone of depression, eliminating the flow of groundwater out of the basin.

The **McMullen Valley Basin** lies partially within the northwestern corner of Maricopa County, although most of the basin is within La Paz County. Approximately 25% of the McMullen Valley Basin landmass is in Maricopa County, which includes the agricultural community of Aguila. Approximately 15.1 million acre-feet of groundwater are available to 1,200 feet below land surface over the entire basin. Recharge of the aquifer is by rainfall and agricultural return flow only. However, withdrawals by agricultural users exceed recharge and cause not only depletion of the aquifer, but the formation of cones of depression as well.

The **Gila Bend Basin**, located in the central part of southwestern Maricopa County, contains 1,280 square miles. The Gila River enters the basin at its northern end near Gillespie Dam, flows south to the Town of Gila Bend, turns west and exits the basin at Painted Rock Dam. Both the younger and older alluvial units yield water for well use. Most of the groundwater pumped in the Gila Bend Basin is used for irrigation. This pumping for irrigation has created several cones of depression in the area around Gila Bend, Cotton Center, and Theba. It is estimated that approximately 27.6 million acre-feet of groundwater are available to a depth of 1,200 feet below land surface in the basin. Groundwater recharge comes from Gila River flow events, water impounded behind Painted Rock Dam, infiltration of irrigation and canal water, underflow from the

Gila River and its tributaries, and direct precipitation. Gila River flood events and dam storage are the largest sources of the 37,000 acre-feet of annual recharge in the basin.

Approximately 20% of the eastern **Lower Gila Basin** is contained in Maricopa County. Groundwater in this basin occurs in both the floodplain and the basin-fill alluvium. Area groundwater is used primarily for irrigation due to the large areas of agriculture in the Hyder and Dendora valleys and the Sentinel Plain. There are approximately 17 million acre-feet of recoverable groundwater in the eastern part of the Lower Gila Basin. Extensive groundwater pumping has created three cones of depression in the eastern portion of the basin. All groundwater presently moves toward these cones of depression rather than toward the Gila River as it did before extensive groundwater pumping occurred. Groundwater recharge comes from runoff, underflow, irrigation excess, and precipitation. Since water levels are continually declining in the eastern part of the Lower Gila Basin, total recharge is assumed to be less than groundwater withdrawals.

Groundwater Subbasins

There are eight groundwater subbasins in Maricopa County, including the East Salt River Valley, West Salt River Valley, Hassayampa, Rainbow Valley, Fountain Hills, Lake Pleasant, Carefree and Vekol Valley. The **East Salt River Valley Subbasin** and the **West Salt River Valley Subbasin** encompass the Phoenix metropolitan area. Since most of these subbasins lie within incorporated areas of Maricopa County, more extensive information concerning groundwater resources is available in the general plans of each municipality. Generally, groundwater availability in the East Salt River Valley Subbasin is approximately 66 million acre-feet to 1,200 feet below land surface and 59 million acre-feet to 1,200 feet below land surface in the West Salt River Valley Subbasin. Groundwater recharge in both subbasins occurs through natural flood flows in ephemeral streams, from mountain front recharge, from incidental recharge of agricultural and urban irrigation, and leakage from canals and artificial lakes.

Groundwater enters the East Salt River Valley Subbasin as underflow from the Lake Pleasant Subbasin, the Eloy Subbasin in Pinal County, and between the Santan and Sacaton Mountains. In the West Salt River Valley Subbasin, groundwater enters as underflow from the Lake Pleasant Subbasin, the northern part of the Hassayampa Subbasin, and the Maricopa-Stanfield Subbasin in Pinal County.

In the East Salt River Valley Subbasin, groundwater flows toward three large cones of depression created by agricultural and municipal groundwater pumping. These cones are located near Scottsdale, Mesa, and Queen Creek. Some groundwater flows from the East to the West Salt River Valley Subbasin, although groundwater pumping in the Maricopa-Stanfield Subbasin in Pinal County has diverted some of this underflow. Most of the groundwater in the West Salt River Valley Subbasin flows toward two large cones of depression located in the Luke Air Force Base area and in the Deer Valley area near the Hedgpeth Hills. However, some groundwater still leaves the subbasin and flows into the southern part of the Hassayampa Subbasin.

The **Hassayampa Subbasin**, covering approximately 1,200 square miles, is located primarily in northwest Maricopa County, although it does extend into the southwest portion of the county. This subbasin is drained by the Hassayampa River, which enters in the northeast and converges with the Gila River east of Arlington. Some groundwater flows southeast into the northern part of the West Salt River Valley Subbasin, although most flows south into the lower Hassayampa area. After passing through the bedrock constriction between the Belmont Mountains and the White Tank Mountains, groundwater flows southwest toward two cones of depression. Created by groundwater pumping for agricultural irrigation, these cones of depression are located in the Tonopah Desert and the Centennial Wash area. Some groundwater enters the southeastern part of the lower Hassayampa area as underflow from the southern part of the West Salt River Valley Subbasin. Most of this underflow is captured by the cone of depression in the Centennial Wash area.

Groundwater replenishment in the Hassayampa Subbasin occurs as streambed recharge from the Gila and Hassayampa rivers and ephemeral streams, from mountain front recharge, and from incidental recharge from agricultural irrigation and canal leakage. Groundwater flow into and out of the subbasin has been calculated at an average of approximately 29,000 acre-feet annually. It is estimated that approximately 4.8 million acre-feet of groundwater are available to a depth of 1,200 feet below land surface in the Hassayampa Subbasin.

Located in the southwestern portion of Maricopa County, the **Rainbow Valley Subbasin** covers approximately 420 square miles and mainly consists of undeveloped desert in the south and agricultural land in the north. Waterman Wash, an ephemeral stream originating in the southern part of the subbasin, drains the subbasin. Groundwater flow in the southern part of the Rainbow Subbasin is in a northwesterly direction. In the northern part of the subbasin, groundwater flows toward a cone of depression created by groundwater pumping for agricultural irrigation. Groundwater recharge sources include streambed recharge from flood flows in Waterman Wash, mountain front recharge, and incidental recharge from agricultural irrigation.

It is evident that groundwater withdrawal, particularly in the northern part of the subbasin, exceeds groundwater recharge. Water levels in the subbasin began declining in the 1950s and had decreased by as much as 200 feet by 1982. The amount of recoverable groundwater in the Rainbow Valley Subbasin has not been quantified.

At least two-thirds of the **Vekol Valley Subbasin** lies within the southwestern portion of Maricopa County. This subbasin is divided into north and south valleys by a bedrock outcropping between the White Hills on the west and the Table Top Mountains on the east.

There is minimal groundwater use in the Vekol Valley Subbasin. The estimated volume of groundwater in storage is 4.6 million acre-feet to a depth of 1,500 feet below land surface. Natural groundwater recharge in the subbasin occurs from precipitation and deep percolation of sheet runoff in stream channels. However, it is surmised that natural recharge is probably minor.

The remaining subbasins in Maricopa County are the Fountain Hills Subbasin, the Carefree Subbasin, and the Lake Pleasant Subbasin. The **Fountain Hills Subbasin** in the northeastern part of the county covers approximately 360 square miles. Groundwater generally flows from the north to the south. Water levels in the subbasin have been affected somewhat by groundwater pumping.

The **Carefree Subbasin** is located in the northeast portion of the county and covers about 140 square miles. Groundwater flows generally from west to southwest, although a cone of depression has formed as a result of heavy groundwater pumping in the past associated with golf courses and exempt wells in the area. Some recharge occurs in the subbasin from mountain front and streambed recharge. Groundwater leaves the Carefree Subbasin and flows into the East Salt River Valley Subbasin. It is estimated that 570,000 acre-feet of groundwater are available to 1,200 feet below land surface within the Carefree Subbasin.

The **Lake Pleasant Subbasin**, located in northern Maricopa County, covers approximately 240 square miles and consists of mainly undeveloped desert. The community of New River, an outlet mall, and a small agricultural area in the southwest part of the subbasin account for most of the groundwater pumping.

Groundwater enters the Lake Pleasant Subbasin from the northeast and flows south until it exits into the West Salt River Valley Subbasin as underflow at the Agua Fria River, and into the East Salt River Valley Subbasin south of the Town of New River. Sources of groundwater recharge include mountain front recharge and streambed recharge from the Agua Fria River, New River, and Skunk Creek. The subbasin is drained by the lower part of the Agua Fria River, by New River, and by Skunk Creek. Groundwater availability in the subbasin has not been quantified, although available information indicates that water levels have been significantly impacted by groundwater use. Many domestic wells near the Town of New River have gone dry, requiring deeper drilling of existing wells and initiation of well impact safeguards.

Effluent
Effluent availability is dependent on the population that is served by wastewater treatment plants.

Capacity for use is directly related to the degree of treatment and the ability to store effluent until it is needed. For uses such as crop and landscape irrigation, recreational impoundment, toilets, and commercial air conditioning, wastewater must receive secondary and tertiary treatment. Secondary treatment is a biological treatment process that produces treated wastewater that meets certain standards for biochemical oxygen demand, suspended solids, pH, and fecal coliform. Tertiary treatment meets higher water quality standards than secondary treatment.

Effluent is used more during the summer months for cooling and irrigation purposes. Since effluent is produced at a fairly constant rate depending on population, it is necessary to store excess effluent generated in the winter months underground or in surface impoundments. To encourage increased use of effluent, the Arizona Department of Water Resources Third Management Plans provide incentives to all municipal, industrial, and agricultural users of effluent.

In 1995, effluent production in Maricopa County amounted to approximately 241,200 acre-feet, while use of effluent in the same year was about 107,400 acre-feet. In 1998, effluent production increased to 257,000 annual acre-feet, while effluent use increased to 175,000 annual acre-feet. The significant increase in effluent use demonstrates the improvements that municipalities have made in the treatment and delivery of this constantly increasing renewable source of water.

Water Supply Analysis

Total water supplies for the county were determined by combining 1995 Phoenix Active Management Area (AMA) effluent production, 1995 CAP water allocations for Maricopa County, and the storage capacity of the seven surface water reservoirs in Maricopa County. Although surface water reservoirs rarely reach full capacity, it is important to note the potential storage capacity. Further, the amount of water in each reservoir fluctuates with time. Added to this total were estimates of groundwater available in all basins and subbasins that lie within the boundaries of Maricopa County and portions of those subbasins that do not lie entirely within Maricopa County boundaries. In 1995, water supplies in Maricopa County totaled 186,960,319 acre-feet. This total is broken down into the following quantities by source: surface water in reservoirs – 2,673,092 acre-feet (includes CAP non-Indian water allocations of 294,822 acre-feet annually); groundwater in storage to 1,200 feet below land surface – 183,688,000 acre-feet; and effluent produced – 286,000 acre-feet annually (**Table 2)**.

Groundwater recharge in most of the basins and subbasins is limited due to the small amount of precipitation in the area, the infrequency of flood events, and the presence of cones of depression. Exceptions occur in the Hassayampa Subbasin where an annual average of 17,400 acre-feet of recharge drops into the aquifer from the Hassayampa River flow below Box Dam, and in the Gila Bend Basin where approximately 37,000 acre-feet of recharge annually occurs from flood events and infiltration of water impounded behind Painted Rock Dam. Recharge also occurs in the East and West Salt

TABLE 2 Water Supply in Maricopa County as of 1995	
Water Source	***Amount Available***
Effluent Produced (Phoenix AMA data, 1995)	**286,000 acre-feet annually**
Storage Capacity of Surface Water Reservoirs (total amount not available at all times)	**2,673,092 acre-feet total (includes 294,822 acre-feet annually of CAP non-Indian allocations*)**
Groundwater	**183,688,000 acre-feet total**
Harquahala Basin	15,500,000 acre-feet
McMullen Valley Basin	3,775,000 acre-feet
	(25% of 15,100,000 total in basin)
Gila Bend Basin	27,600,000 acre-feet
Lower Gila Basin	3,400,000 acre-feet
	(20% of 17,000,000 total in subbasin)
Hassayampa Subbasin	4,807,000 acre-feet
Vekol Valley Subbasin	3,036,000 acre-feet
	(66% of 4,600,000 total in subbasin)
Rainbow Valley Subbasin	Unknown
Fountain Hills Subbasin	Unknown
Carefree Subbasin	570,000 acre-feet
Lake Pleasant Subbasin	Unknown
East Salt River Valley Subbasin	66,000,000 acre-feet
West Salt River Valley Subbasin	59,000,000 acre-feet
*Does not include Indian CAP allocations	

River Valley subbasins along the Salt River, the Agua Fria River, the Gila River previously mentioned, and Queen Creek.

Estimated maximum potential recharge along the Salt River for the 10-year period from 1978 to 1988 was 1,000,000 acre-feet. Data for this estimation was collected along the Salt River from Granite Reef Dam to the 91st Avenue Wastewater Treatment Plant. Estimated potential recharge along the Agua Fria River from Waddell Dam to the river outflow at Avondale (1978 to 1988) equaled 460,000 acre-feet for the ten year period. Along Queen Creek, estimated recharge for the ten year period from 1978 to 1988 was approximately 79,000 acre-feet.

Historical Water Demand

Water use in Maricopa County in 1995 was compiled from Arizona Department of Water Resources Phoenix AMA water use data and from water use data provided by the Town of Gila Bend and the Town of Wickenburg. Additionally, exempt well water use outside of the Phoenix AMA was calculated using the number of registered exempt wells and the methodology used for calculating exempt well water use within the Phoenix AMA. An exempt well is any well with a pump capacity of 35 gallons per minute or less that is exempt from Arizona Department of Water Resources reporting requirements. Based on these data, total water use for Maricopa County in 1995 was 2,068,783 acre-feet.

Projected Water Demand

Projected water demand in Maricopa County for the year 2020 was calculated from Phoenix AMA projected water use data, as well as 1995 Special Census data, projected water demand from recently approved power plants, and projected exempt well use outside the Phoenix AMA. The total projected water demand for 2020 is 2,560,900 acre-feet. This translates to approximately 57,500,000 acre-feet of water use from 1995 through 2020 for the entire county.

Issues

Land Subsidence and Earth Fissures

In certain areas, groundwater pumping has resulted in land subsidence and the creation of earth fissures. Land subsidence occurs when more water is withdrawn from the ground than is recharged. The water in an aquifer supports part of the load of the overlying materials and keeps the grains of the aquifer loosely packed. As water is removed from the spaces in an aquifer, the weight of the overlying rocks packs the grains together more closely, permanently reducing the capacity of the aquifer and causing subsidence of the ground overlying the aquifer. Earth fissuring occurs when the land surface subsides and begins to crack. Fissures can become quite wide and can extend many miles. Land subsidence and earth fissuring has been documented in metropolitan Phoenix in the east Mesa, Apache Junction, Queen Creek, Litchfield Park, and Paradise Valley areas, and outside metropolitan Phoenix in the Harquahala Valley, Gila Bend Basin, and near Tonopah in the lower Hassayampa area.

Water Quality

Groundwater quality throughout Maricopa County is generally characterized as fair to good, particularly in unincorporated areas. In some areas, treatment for fluoride and total dissolved solids (TDS) is necessary before human consumption is possible. Poor quality water can be found in the upper hydrogeologic unit, which consists mainly of sand and gravel with some silt and clay. The upper unit ranges in thickness from 100 feet to over 500 feet in some parts of the basins. Poor quality water is generally found only in the East and West Salt River Valley subbasins, with contaminants including TDS, sulfates, nitrates, volatile organic compounds (VOCs), pesticides, and metals. The major activities that produce these contaminants are industry, agriculture, dry well injections, unregulated landfills, and leaking underground storage tanks. Many wells previously used in the Phoenix area for drinking water purposes can no longer be used because of contamination.

Surface water pollutants come from both point and non-point sources. Point sources include pipes, channels, tunnels, and ditches that discharge pollutants. Non-point sources include, but are not limited to, runoff from agricultural fields, vacant lots, construction sites, and urban development. In Maricopa County, agriculture, industry, construction, wastewater treatment plants, drinking water treatment plants, natural sources, hydromodification, landfills, and resource extraction contribute to surface water pollution. Metals, TDS, turbidity, suspended solids, pathogens, and pesticides are contaminants associated with surface water pollution. Regulatory agencies and environmental legislation have resulted in greater attention to the mitigation of existing pollution problems and the prevention and mitigation of future problems.

Central Arizona Project (CAP) water is subject to a comprehensive water quality testing program. This program not only protects the integrity of CAP water used for recharge, but also allows customers who receive raw, untreated water for treatment and delivery to the public to adjust their water treatment systems. CAP further ensures the health of the public by minimizing exposure to human generated pollutants. The quality of CAP water is good, however, some characteristics of river water, like hardness determined by high levels of calcium and magnesium, are evident.

Utilization of Renewable Supplies

Historically, groundwater has been the primary water source for municipal, industrial, and agricultural water users in Maricopa County. In most cases, groundwater is usually less expensive and easier to obtain than renewable supplies. Some constraints to using renewable supplies include the inability to pay the cost of renewable supplies and the cost of the infrastructure required to transport these supplies, and an absence of legal rights to use the renewable supplies. Other limitations evolve from regulations and policies governing the use of renewable supplies, and from environmental constraints associated with its use. However, it is important to note that these constraints also apply to the use of groundwater, from paying the cost of infrastructure used for groundwater transport to the environmental constraints caused by extracting vast amounts of groundwater from aquifers.

Assured Water Supply

The Assured Water Supply Program (AWS Program) was established in 1980 through the Arizona Groundwater Management Act to provide long-term certainty regarding water supply availability for new development, to promote long-range water supply planning in areas with significant water management problems and to ensure that renewable supplies are used to meet the demands of municipal growth. The demonstration of a 100 year water supply (sufficient water of adequate quality for at least 100 years) for any new subdivision within an AMA is the primary requirement for granting a Certificate of Assured Water Supply (for a subdivision plat not served by a designated water provider) or a Designation of Assured Water Supply (for a city, town, or private water company). The Central Arizona Groundwater Replenishment District (CAGRD) was subsequently established to provide a method of meeting the consistency with AMA management goal requirement of the AWS Program. The CAGRD is responsible for replenishing the aquifer with CAP water to replace groundwater that is pumped to meet the demands of members of the district. However, replenishment does not necessarily take place within the same subbasin from which groundwater was withdrawn. Therefore, groundwater pumping may deplete an aquifer in one area, while other areas benefit from replenishment. Since all new subdivisions must demonstrate the use of renewable supplies or join the CAGRD, most municipal water use will gradually transition to renewable supplies. This will help reduce long-term groundwater use.

Adequate Water Supply

The Assured Water Supply Rules don’t apply outside an AMA. Subdivision development outside an AMA must demonstrate whether or not an adequate water supply will be available for 100 years to meet the water demands of the development. To obtain an adequate water supply determination, physical, legal, and continuous water availability for 100 years must be demonstrated, as well as meeting the existing water quality standards. Subdivisions outside an AMA can also obtain a written commitment for water service from a city, town or private water company that has a demonstrated adequate water supply. A developer is not prohibited from building a subdivision that has not demonstrated an adequate water supply, but the initial buyer must be notified of whether or not an adequate water supply does exist for the subdivision.

Effluent Use

Effluent is available at a constant rate and must therefore be stored during low demand periods for use during high demand periods. Effluent storage results in substantial investments for municipalities and municipal water providers. Treatment of effluent to meet Arizona Department of Environmental Quality standards also requires considerable expense. Delivery of effluent to irrigated farmland, for cooling purposes, and for use in landscape irrigation and decorative lakes requires expensive infrastructure that in some cases prohibits its use. New standards have been developed which, if met, provide additional uses of treated effluent, such as irrigating certain food crops.

Developing advanced treatment technologies that can remove potential health hazards, such as bacteria, viruses, and pharmaceutical by-products is necessary. Advanced treatment technologies will help enhance public acceptance of more widespread use of effluent as a viable water source.

Indian Community Water Claims

Demand for water by Indian communities will have a dramatic impact on water management in Maricopa County. Negotiations with the Salt River Pima-Maricopa Indian Community and the Fort McDowell Mohave-Apache Indian Community resulted in settlements with tribal water budgets of 122,400 acre-feet and 35,950 acre-feet of annual water, respectively.

The Gila River Indian Community claims an annual entitlement to over 1.5 million acre-feet in the Gila River General Stream Adjudication. The federal government presented a settlement water budget for an annual entitlement to 653,000 acre-feet. Discussions have taken place between the Gila River Indian Community and many parties, but a full settlement may await a determination of the quantity of CAP water available for Indian settlements and the costs associated with CAP water.

Riparian Habitats

Preservation of riparian habitats depends in part on the supply of groundwater or effluent available to maintain these areas. Effluent that has been previously discharged into existing streambeds has created riparian habitat. Both groundwater and effluent are continuously needed to maintain such areas. Increasing use of effluent may limit the supply available to allow riparian habitat to continue. As such, it may be necessary to provide a means of supplying renewable sources of water for use by riparian areas.

Supplying Future Population

Table 2 displays available water supplies from all sources in Maricopa County. Renewable water supplies (CAP, surface water, and effluent) are displayed separately. Groundwater supplies are broken down by availability in each basin or subbasin within the county. The total water available for the entire county is approximately 186,960,000 acre-feet.

The amount of effluent available for use by county residents is derived from the amount produced within the Phoenix AMA. There are no other entities within the county that produce a significant amount of effluent at this time. However, it is becoming common for small communities and master planned developments to build treatment plants to process wastewater into treated effluent that can be used within a community. In 1995, communities within the Phoenix AMA used approximately 107,400 acre-feet of the 286,000 acre-feet of effluent produced. About 25% of this amount was used by the Palo Verde Nuclear Generating Plant.

Most available CAP water is already allocated to users within the Phoenix AMA. Approximately 10 to 12 entities made use of their CAP allocations in 1998. It is projected that by the year 2020, most entities with CAP allocations will be fully using their allocated amount as well as additional amounts leased from Indian communities.

Surface water is limited primarily to users in the Phoenix AMA and, more specifically, within the incorporated areas. Outside the incorporated areas, the amount of surface water is very limited, with only approximately 116,000 acre-feet available as annual flow in the Gila River, the Hassayampa River, and Centennial Wash combined. Essentially, however, all river flow is currently appropriated under state law.

Much of the West Salt River Valley, East Salt River Valley, Lake Pleasant, and Carefree Subbasins are located in incorporated areas or on developed land. Groundwater availability in these subbasins totals 125,570,000 acre-feet. The balance of groundwater available in the unincorporated and largely undeveloped areas of Maricopa County totals 58,118,000 acre-feet. Because CAP water and surface water is, for the most part, unavailable in the unincorporated areas of the county, future population in these areas will need to rely on effluent and groundwater to meet their water needs.

Summary

Management of future water supplies will need to be both adaptable and comprehensive. The authorities granted to the Arizona Department of Water Resources, the Arizona Department of Environmental Quality, and the CAWCD will need to be coordinated to allow for the best management of available water resources. Some management practices that should be considered to ensure supplies are available in the future include the following:

- Water management should include demand management programs and supply augmentation. Augmentation of supply should include use of renewable supplies instead of non-renewable groundwater, storage of excess renewable supplies for future use, effluent use and, when possible, use of renewable supplies to meet new demands. Water conservation and regulating artificial lakes should be central for demand management.

- Water management should be a long-term practice and should be effective throughout the region.
- Water management efforts should be based on sound economic principles. Public and private funds used to achieve water management goals should be used as effectively and efficiently as possible.
- Water management efforts should enhance the quality of life for the community.
- Water users should be responsible for the development and implementation of water management programs.
- An effective long-term water management strategy should include all water sources.
- Involve the public in developing management programs, and educate the public on water issues.
- Regional water management strategies should be done only after consideration of their impact on local water users.

Conservative use of non-renewable water supplies is vital to the future of water availability in Maricopa County. Increased use of renewable sources such as CAP water, surface water and effluent is an essential element of water management now and in the future.

Goals, Objectives, and Policies

This section identifies comprehensive goals, objectives, and policies to address water resources for Maricopa County, and help support and implement *Eye to the Future 2020*. To help understand the intent of these items, the following definitions are provided:

Goal: A concise statement describing a condition to be achieved. It does not suggest specific actions, but describes a desired outcome.

Objective: An achievable step towards a goal. Progress towards an objective can be measured and is generally time dependent.

Policy: A specific statement to guide public and private decision making. It is derived from the goals and objectives of the plan.

The goals, objectives, and policies are the action component for addressing water resources in *Eye to the Future 2020.* Therefore, land use decisions should be made in coordination with the goals, objectives, and policies contained in this section.

Goals, objectives, and policies come from the research contained in this report, as well as from discussions with numerous stakeholders and participants.

The following are the goals, objectives, and policies for the water resources element.

Goal One: *Promote development that makes conservative use of renewable water supplies such as effluent, surface water, and Central Arizona Project water when feasible, and that uses groundwater as the primary water source only in the absence of renewable sources.*

Goal Two: *Reduce the impacts of development on water quality, land subsidence and fissuring, and riparian habitat.*

Objective W1 **Encourage the protection and enhancement of future renewable water and groundwater supplies within the framework of state and federal laws, regulations, and guidelines.**

Policy W1.1 Encourage development in accordance with state and federal laws, regulations, and guidelines that govern water quality.

Policy W1.2 Encourage compliance with Arizona Department of Water Resources programs, rules, and regulations for new development.

Policy W1.3 Encourage compliance with water conservation guidelines set by the Arizona Department of Water Resources.

Policy W1.4 Encourage development which complies with the Aquifer Protection Permit program.

Policy W1.5 Encourage the use of crop fertilization and pest management practices that reduce risk of groundwater and surface water contamination.

Policy W1.6 Encourage the use of effluent and treated industrial wastewater.

Objective W2 Ensure adequate facilities are available for the treatment of wastewater, and the distribution of effluent, in newly developing areas.

Policy W2.1 Encourage provisions for wastewater treatment and reuse for new development.

Policy W2.2 Encourage compliance with Arizona Department of Environmental Quality

standards for effluent treatment and reuse.

Objective W3 Encourage the reduction of pollutants in rivers, streams, and washes within the framework of state and federal laws, regulations, and guidelines.

Policy W3.1 Cooperate with the Arizona Department of Environmental Quality biannual Water Quality Assessment Report in accordance with the Clean Water Act.

Objective W4 Promote the protection and preservation of riparian areas within the framework of state and federal laws, regulations, and guidelines.

Policy W4.1 Encourage site evaluation and classification of riparian areas as required by the US Army Corps of Engineers 404 permit program or by other state or federal laws, regulations, and/or guidelines.

Policy W4.2 Consider incentives and options for preservation of riparian areas.

Appendix A: Acronym List

ADWR	Arizona Department of Water Resources
AMA	Active Management Area
A.R.S.	Arizona Revised Statute
AWBA	Arizona Water Banking Authority
AWS	Assured Water Supply
CAGRD	Central Arizona Groundwater Replenishment District
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
SRP	Salt River Project
TDS	total dissolved solids
VOCs	volatile organic compounds

Appendix B: References

Arizona Department of Water Resources, 1988. Arizona water resources file data, Hydrology Division.

Arizona Department of Water Resources, 1993. A Regional Groundwater Flow Model of the Salt River Valley – Phase I, Phoenix Active Management Area Hydrogeologic Framework and Basic Data Report.

Arizona Department of Water Resources, 1994. A Regional Groundwater Flow Model of the Salt River Valley – Phase II, Phoenix Active Management Area Numerical Model, Calibration and Recommendations.

Arizona Department of Water Resources, 1994. Arizona Water Resources Assessment, Vol. I – Inventory and Analysis.

Arizona Department of Water Resources, 1994. Arizona Water Resources Assessment, Vol. II – Hydrologic Summary.

Arizona Department of Water Resources, 1999. Third Management Plan, Pinal AMA. p 2-5.

Arizona Department of Water Resources, 1999. Third Management Plan, Phoenix AMA.

Arizona Department of Water Resources, 2000. Governor's Water Management Commission Briefing Notebook, Commission Support Staff.

Arizona Department of Environmental Quality, 1994. Arizona Water Quality Assessment.

Arizona Water Banking Authority, 1998. 1998 Annual Report.

Arizona Water Banking Authority, 1999. Annual Plan of Operation, 2000.

Arizona Water Banking Authority, 1999. 1999 Annual Report.

BRW, Inc. and Sunregion Associates, Inc., 1986. Wickenburg General Plan, December 1987.

BRW, Inc. and Sunregion Associates, Inc., 1996. Town of Gila Bend Master Plan Update, September 1996.

Central Arizona Project, 1997. 1997 Annual Report.

Central Arizona Project, 1999. 1999 Annual Report.

Central Arizona Project, 1999. 2000 CAP Budget.

Corkhill, E.F., Corell, Steve, Hill, Bradley, Carr, David, 1993. A Regional Groundwater Flow Model of the Salt River Valley – Phase I, Modeling Report No. 6.

Corell, Steve and Corkhill, E.F., 1994. A Regional Groundwater Flow Model of the Salt River Valley – Phase II, Modeling Report No. 8.

Denis, E.E., 1971. Groundwater Conditions in the Harquahala Plains, Maricopa and Yuma Counties, AZ.

Halpenny, L.C. and Halpenny, P.C., 1988. Evaluation of Groundwater Supply at Sun Valley Project Hassayampa Plain, AZ.

Maricopa Association of Governments, 2000. Valley Vision 2025 Vision Report.

Maricopa County Planning and Development Department, 1997. Maricopa County *Eye to the Future 2020*.

Morrison Institute for Public Policy, 2000. Hits and Misses: Fast Growth in Metropolitan Phoenix. Arizona State University, Tempe, AZ.

Mock, Peter, 2000. Evaluation of Groundwater Responses to Pumping for Proposed Power Plants in the Centennial Wash Area, Maricopa County, AZ.

Personal Communication with Mark Lemon, Town of Wickenburg, January 8, 2001.

U.S. Department of Agriculture Soil Conservation Service, 1977. Final Environmental Impact Statement, Harquahala Valley Watershed, Maricopa and Yuma Counties, AZ.